The economic miracle and well-being in Italy
An analysis on regional convergence in military conscripts' height during the mid-twentieth century

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1. Introduction

1.1. Anthropometric measurements are commonly used by economic historians and economists to assess the biological standard of living of a nation, and any economic disparities between countries or regions, since economic variables, such as current per capita, income and real wages, were judged unsatisfactory. The limitations of monetary measures awakened an interest in less conventional measurements, such as height, focusing on changes in adult body size and growth processes across generations, which have been defined «secular trends in height» (Ulijaszek 1998). Because such changes in height are sensitive to fluctuations and variations in economic, cultural, and environmental conditions, height may proxy for a population's biological standard of living (Eveleth, Tanner 1976; van Wieringen 1986). While the increase in average height around the middle of the nineteenth century is consistent with empirical data in many countries[1], it is not easy to disentangle the contribution of the various factors underlying this process. Many scholars have focused on the potential determinants of height, such as nutritional intake and morbidity, public sanitation, real income, labour intensity and medical progress (Tanner 1981; Floud, Wachter, Gregory 1990; Steckel 1995), as well as on its consequences (Steckel 2009; for a synthesis see Komlos 1998; Komlos, Baten 2004). Specifically, in addition to genetic factors, the environmental and economic circumstances experienced during infancy and adolescence affect height growth and, consequently, final adult height. Indeed, according to Tanner (1989[2]), height growth is characterised by two intense periods occurring during infancy, in which the greatest increment in height occurs, and in adolescence, in which the rate rises sharply to a peak, corresponding to about one-half of the rate experienced during infancy. Thereafter it declines rapidly, reaching zero during adulthood. Adult height is established by the process of accumulation of a series of determinants during the years from birth to adulthood when the final height is reached. The balance between nutritional intake, in quantitative and qualitative terms, and the physical effort and energy used to live, work and fight diseases strongly impact height. Since income is an important determinant of food consumption, «systematic differences in adult height may also be informative about differences in real incomes» (Peracchi 2008, 475). This implies that changes in height reflect the influence of socio-economic and environmental improvements caused by economic growth.

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1.2. Aim and empirical strategy. In this paper, we investigate the impact on well-being of the process of economic growth known as the 'economic miracle', which occurred in Italy from the end of World War II to the beginning of the 1970s, a period of extraordinary success for Italy and Europe as a whole (Nardozzi 2003).

The unprecedented economic and social transformation and increases in employment and real income led the country to become one of the most developed economies in Europe. During this period, Italy enjoyed a remarkably rapid growth rate of GDP per capita – more than 5 percent per year – reaching a level enjoyed by the most advanced countries in the world (Crafts, Magnani 2011). However, this process was not homogeneous throughout the country, and while there is evidence that the South advanced during the decades 1951-71, when the growth of Italian economy was most intense, regional income inequalities persisted over the long run (Felice 2015).

We analyse in depth whether these changes led to a reduction in regional inequalities in the biological standard of living, i.e., if people living in Southern Italy benefited to the same degree from the significant improvements in the standard of living. Italy is an interesting case-study, since anthropometric studies reveal the existence of major regional disparities in terms of height with respect to other European countries (Arcaleni 2006; Felice 2007; Peracchi 2008; A'Hearn, Vecchi 2011; Lanari, Bussini, 2014). Numerous studies concerning convergences (or divergences) in stature between geographical areas have been conducted. With respect to Europe, Komlos (2007) analysed height convergence across regions of the Habsburg Empire in the nineteenth and early twentieth centuries, showing a gradual convergence towards the end of the century. Other studies on the evolution of the biological standard of living conducted in Usa (Chanda, Craig, Treme 2008) from 1820 to 1900 and Columbia (Meisel, Vega 2007) over the 20th century revealed a reduction of inequalities among geographical regions, denoting that a process of height convergence was in act even if in some periods patterns of divergence emerged. Salvatore (2004) evidenced an internal convergence in stature in the north-west region of Argentina during the first half of the 20th century, but these improvements did not permit the stature catching-up with respect to other parts of the country due to considerable differences in skills, education and social standing throughout the country.

We first describe the correlation between height and the indicator of economic development, namely per capita income measured at birth, to explain changes in adult height during the period 1927-1980. Then, we extend the Solow type economic growth model (Barro, Sala-I-Martin 1992a) to derive an equivalent reduced form for height and test whether the regions of Southern Italy experienced a 'biological convergence' focused in the period 1951-80. The unexpected changes in economic development (i.e., the economic boom for Italy) are assumed to have stimulated improvements in height with a different magnitude in height changes across Italy. Traditional analyses of the economic convergence, such as Barro (1991) and Barro and Sala-i-Martin (1992b), used cross-sectional framework in which the income growth rate and explanatory variables were observed in a time-period only. Here, we use a panel setup for decade subsamples, because the time-series dimension provides some additional information and can consistently estimate a system in more than one equation. To isolate the exogenous variation of the economic boom on height, we then rely on the historical data on height, used as instrumental variables (IV) (see Tabellini 2010).

1.3. Data source. We estimate convergence in the biological standard of living through the national and regional height data of military conscripts recorded during medical examinations. Time series of mean height have been officially published by the Istituto Nazionale di Statistica (Istat) for Italian male conscripts born during 1854-1980, whereas at the regional level the span is from the 1927 to 1980 birth cohorts[2]. It is important to stress that Istat data on height do not suffer from problems of truncation typical of historical samples based on recruits, since national recruitment of young men for military service was compulsory; thus, all conscripts were measured even if they did not meet the minimum height required for military service. Conscripts were measured at age 18-20 years with few exceptions when medical examination was, only occasionally, performed at a younger age depending on the particular military needs. To overcome this problem, Istat provided a standardized height series corrected for age-based differences, resulting in an important effect upon conscripts born at the end of the nineteenth century who were drafted at a younger age (17 years old) because of World War I. Apart from these cohorts, actual and standardized height estimates from the 1930 birth cohort seem to generally coincide, so that no corrections were required from the 1954 birth cohort onwards. Conscripts born from 1960 onward took the medical examination at age 18 years. Since in a preliminary analysis we use height data at the regional level for birth cohorts 1927-1980, the potential error deriving from changes in the recruitment ages is negligible. Despite the generally good quality of conscript data, certain problems require attention such as rounding, heaping, and the selection effect due to draft dodging for older cohorts and the exclusion of Navy conscripts, even if the latter consists in very small percentages (Arcaleni, 2006). Yearly series of Italian regional per-capita income were extracted by Daniele and Malanima (2007), who homogenised different regional sources for the period 1891-2004.

2. Height and economic growth in Italy

2.1. A high correlation between height and economic development was observed during the second half of the twentieth century (Steckel 1995). Arcaleni (2006) clearly showed an average height increase of 12.2 cm – from 162.4 to 174.6 cm – over more than one century among the Italian conscript cohorts of the post-Unification period (1854-1980). Interestingly, a strong increase in the biological standard of living, as well as a significant increase in per capita income, emerged after the World War II when Italy went through a fairly long period of economic growth. As evidenced by Hatton and Bray (2010), the gain in height for Italian conscripts is in line with that experienced by other Western European countries from the 1870s to the 1970s. The correlation between increases in physical stature and improvements in sanitary conditions and food intake for conscripts born at the end of the nineteenth century was highlighted by Federico (2003). A'Hearn, Peracchi, Vecchi (2009) were able to show, through their age-adjusted provincial height distribution, that the adolescent growth spurt (AGS) occurred later in Italian provinces with shorter mean heights, implying an influence of environmental factors rather than genetic ones. They also offer new insights into the regional development disparities in the late nineteenth century across Italian areas, shown by the transition from provincial height convergence for conscripts born from 1855 to 1880 to divergence after 1880, in accordance with the widening of economic disparities between the North and the South (see also Peracchi 2008). Peracchi and Arcaleni (2011), by using data on young Italian males born between 1973 and 1978, found that economic conditions, proxied by income per capita, have a significant impact on average height, more so than other variables related to a healthy environment in early life. A'Hearn and Vecchi (2011) evidenced a high level of well-being even in the most industrialized northern regions (Piedmont, Lombardy and Liguria), while other countries, such as United Kingdom and United States, suffered declining heights linked to the hardships of the industrialisation process (Komlos 1998; Steckel 2009).

2.2. Predicting the relationship between per-capita income and height. We use the time series of regional per-capita income in the year of birth as a proxy for early-life environment to test the correlation with adult height. Bassino (2006) assumes that the body height at the time of military medical examination is the result of a cumulative process largely based on poverty and disease at the time of birth. Unlike Bassino (2006), who has no data with sufficient lags to perform the hypothesis in Japan, we use a 20-year lag of per-capita income for testing it in Italy.

The above-mentioned relationship is tested in semi-log form following the approach of Steckel (1995) and can be explored by matching data from the yearly series of regional per-capita income (Daniele, Malanina 2007), with conscript height data from 1927 to 1980 birth cohorts[3].

The relationship between per-capita income and height can be represented by the equation (1) in which the regional dummy variables are included in an attempt to capture other common regional determinants of biological welfare. Formally:

$$H_{it} = a + \beta log Y_{i,t-20} + \sum_{i=2}^{16} \gamma_i D_i + \epsilon_{it} \qquad (1)$$

where H_{it} is the mean stature in region i (in cm) in year t, $Y_{i,t-20}$ is the real per-capita income (in constant Lire at 1951) in year t-20, D_i is a dummy variable for different Italian macro-areas and ε_{it} is the error term assumed to be normal and independent and identically distributed.

It is worth noting that the implicit causation between per-capita income evaluated in the year of birth and adult stature avoids endogeneity issues detected when the relationships are estimated simultaneously.

Table 1 lists the estimated coefficients of regressions of mean height on the log per-capita income. The log per-capita income variable, as well as the coefficients of macro-areas in the specification (I) has the expected sign and is significant at the usual 5% threshold level. In particular, using the Island macro-area as the height reference, we predict a height differential of +2.71 cm for conscript residents in the North-West of Italy and +3.68 cm for conscript residents in the North-East.

Tab. 1. *Regressions of mean height on the log per-capita income (1927-1980 birth cohorts)*

	Full sample regression		Height
Variables	Model (I)	Model (II)	Sample mean
Intercept	114.4 *	114.9 *	
	[1.12]	[0.99]	
Log per-capita income	4.35 *	4.29 *	12.484
	[0.09]	[0.08]	
Island (reference)			167.897
North-West	2.71 *	3.17 *	172.398
	[0.19]	[0.17]	
North-East	3.68 *	3.73	173.260
	[0.20]	[0.18]	
Centre	2.76 *	2.77 *	171.989
	[0.17]	[0.15]	
South	1.34 *	1.31 *	168.680
	[0.17]	[0.15]	
Dummy of migration from South to North (1950-1965)		0.37 *	
		[0.09]	
R^2	0.84	0.87	
N. of observations	720	720	

Notes: standard errors of coefficients are reported in square brackets; * suggests significant levels of the estimated parameters with p-values < 0.05. Growth rate is calculated in log form. North-West: Piedmont, Lombardy, Liguria. North-East: Veneto, Emilia-Romagna. Centre: Tuscany, Umbria, Marche, Latium. South: Abruzzo, Campania, Apulia, Basilicata, Calabria. Islands: Sicily, Sardinia. Conscript height regional data were reported by Istat from 1927 to 1940 and continuously from 1945 to 1965. Data for conscripts were missing in the 1966, 1968, 1970 and 1971. Observations: 16 regions *45 years.

We also estimate the model II by including the dummy variable for the period 1950-1965, which proxies for internal migration from Southern to Northern regions which represented the 78% of total migration flows. Since the 1950s, Italy witnessed large waves of internal migration mainly from the underdeveloped South to the rich North, and from rural to urban places, reaching a peak during the second half of the 1960s. Bonifazi (2015) estimated migration flows by Istat data, showing that the largest intensity of internal migration from South to North, caused by the desire of southerners to improve their living conditions and job opportunities, occurred between 1961 and 1963. The main destination of migrants was cities in the northwest, which were undergoing extensive industrial development, and the capital city of Rome. East-west movements were another distinguishing feature of migration, especially from the Veneto to Lombardy and Piedmont, although to a lesser extent (Golini 1978; Bonifazi, Heins 2000). We confirm the robustness of the results with significant coefficients of log income per-capita and macro-area differences that are close to the estimation in Model (I). In addition, we estimate a significant impact of the dummy variable, which proxies internal migration, with an under-estimation on height growth of 0.37 cm (confidence interval: 0.2-0.55), mainly affecting the height of conscripts born and residing in the North-West. We conclude that the migratory flow of people to Northern Italy may be partly responsible for the slowing of mean stature of this macro-area.

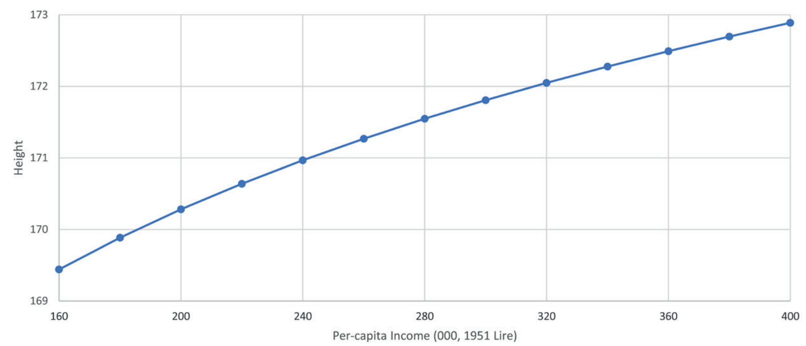
Figure 1 illustrates the relationship between predicted height, which we obtained from regressions, and values of per-capita income, measured at birth (constant 1951 Lire). It emerges that per-capita income has diminishing returns on mean height, suggesting that once necessities are satisfied, higher income impacts less on health and physical growth. In line with Deaton (2007), Italian data that cover periods of deprivation and development seems to confirm that height is a good measure of deprivation but not of opulence.

3. Regional disparities and convergence in height in Italy: a descriptive analysis

Now, we illustrate the existence of a height convergence across the Italian regions driven by the economic boom. Table 2 shows the growth rate of regional mean height after World War II for specific sub-periods and aggregates it for macro-areas.

The height growth rates of the first two decades after World War II (1951-1961 and 1961-1971) indicate a higher magnitude of the Southern area. While the generalized economic boom that involved the whole Italy at the end of the 1950s has certainly delayed the catch-up in height, we note a sharp difference, more than double, in the height growth rate of young soldiers in the South and Islands with respect to North-Centre during the decade 1961-1971 (e.g. 0.33% in the North-West *versus* 1.08% in the South). Economic history literature has acknowledged the importance of the extraordinary public interventions known as 'Cassa per il Mezzogiorno' in order to support the development of Southern Italy and reduce regional inequalities within the country (Lepore 2011; Felice, Vecchi 2015). Created in 1950, the 'Cassa per il Mezzogiorno' was intended to focus on basic infrastructures and the spread of industrialization in Southern Italy. However, in the absence of the modernization of the socio-institutional environment, the only massive financial resources channelled towards the most underdeveloped regions of the South were not enough to guarantee economic growth in the long-term, because of increasing difficulties in engaging local resources in productive activities (Felice, Vecchi 2015). This may suggest that the lack of per-capita income convergence at regional or provincial level, which has been widely recognized in Italy, except for the period 1960-1974, generated differences in the long-run trends between economic growth and biological well-being growth, and may explain the heterogeneous results obtained in the literature on economic growth and development using different time series and administrative areas (see, for example, Paci, Pigliaru 1997; Costantini, Arbia 2006).

Fig. 1. *Per-capita income and predicted (mean) height*



Notes: height estimates are obtained from the predicted values of equation (1), specification I.

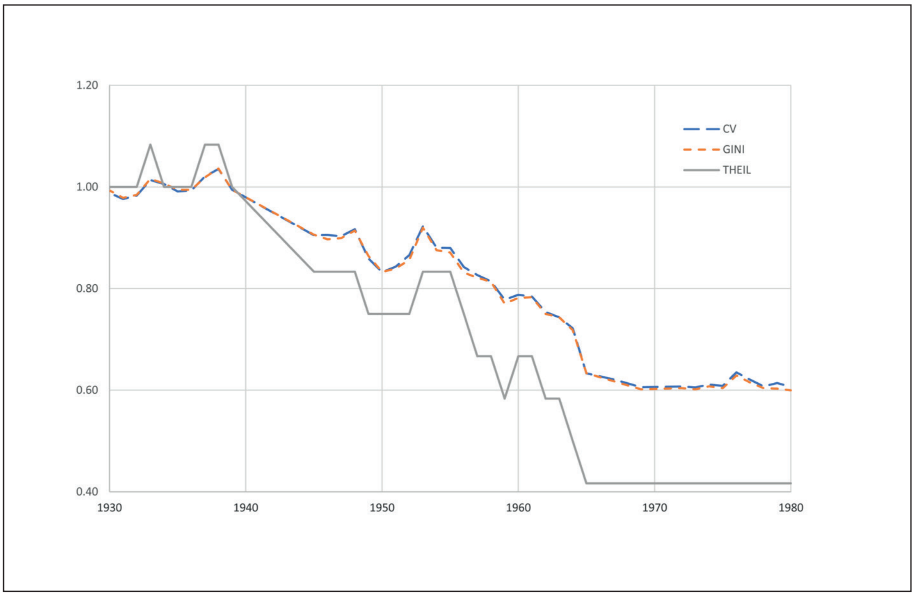
Tab. 2. *Growth rate of height (birth year) by Italian macro-area (%)*

	1951-1961	1961-1971	1971-1980
North-West	1.430	0.330	0.310
North-East	1.380	0.490	0.450
Centre	1.512	0.340	0.560
South	1.570	1.080	0.480
Islands	1.663	0.930	0.470

Notes: growth rate is calculated in log form. North-West: Piedmont, Lombardy, Liguria. North-East: Veneto, Emilia-Romagna. Centre: Tuscany, Umbria, Marche, Latium. South: Abruzzo, Campania, Apulia, Basilicata, Calabria. Islands: Sicily, Sardinia. Although height in 1971 was missing, we interpolated the conscripts' height between 1969 and 1972 and used it as a proxy for height in that year.

To analyse the patterns of regional height inequality in Italy in depth, we estimate it between 1927 and 1980, using the coefficient of variation of height (CV), Gini and Theil indexes, which can be taken as measures of σ-convergence (i.e., decrease of height dispersion). The patterns in Figure 2 suggest that after World War II and until 1970, there was a clear convergence in mean height for conscript cohorts, while after this date differences are statistically not relevant. As argued in section 2, we must note that this improvement in biological welfare in the South was affected by the migration flows of people from Southern to Northern Italy in the 1960s, which (artificially) slowed the rate of mean growth height in the latter macro-area, given the shorter height of Southern people.

Fig. 2. *Regional disparities in height (birth year): σ-convergence*



To sum up, there is an evident reduction in disparities after the World War II among the Italian regions in per-capita income terms and height, although there may be a mismatch of these growth effects. While height grew considerably in all areas of Italy in the period right after the World War II due to improvements in the socio-economic environment, the economic boom affected income and height specifically during the 1960s, clearly with greater effect for the Southern regions. Thus, the decrease in the σ-convergence of the Italian regions we illustrated represents a sufficient condition for testing the catching up of height (biological welfare) at the regional level.

Below, we use a β-convergence model for testing the catching up of Italian regions in the increase in biological welfare.

4. Empirical model

4.1. The pattern of σ-convergence in the height of Italian conscripts during the 20th century is largely explained by per-capita income at birth (i.e., early life conditions), although there have been historical periods, in which these variables were not perfectly associated. For example, government intervention for reconstruction after the World War II or the specific intervention 'Cassa per il Mezzogiorno' in Southern Italy may be responsible for improvements in regional development and well-being, which anticipated positive shifts in per-capita income (Felice, Vecchi 2015).

On the one hand, this evidence allows us to extend the growth model properly including the initial level of height for each period investigated, instead of per-capita income at birth. On the other hand, specifying the (initial) level of height with respect to the growth rate in the catching up model may lead to reverse causality issues and estimation bias. In fact, the initial average height recorded as an explicative variable may be positively correlated with the current socio-economic and health variables involved in the convergence process, which in turn leads to an overestimated reduction of height disparities. To account for this methodological issue, we will estimate the model by an IV approach.

4.2. A stylized model. We describe a formal model to test the hypothesis of regional catching up in biological welfare by the β-convergence of height. We extend a neoclassical growth model in Barro and Sala-I-Martin (1992b), which is grounded on the impact of physical capital on per-capita income. Under the usual Cobb-Douglas production function, Bassino (2006) specifies a β-convergence model for the physical capital growth, which overlaps not only per-capita income growth, but with height growth too. The model extension includes the concept of absolute and conditional convergence in height.

Formally, the equation (2) is a differential equation in log of the height (log H) with the solution,

$$logH(t) = \left(1 - e^{-\beta t}\right)\log(H^*) + e^{-\beta t}\log\left(H(0)\right) \tag{2}$$

In discrete time, corresponding to annual data, height for a population i, irrespective of group of regions or families, can be approximated by,

$$\gamma_{i,t} = log\frac{H_{i,t}}{H_{i,t-1}} = a - \beta logH_{i,t-1} + u_{i,t} \tag{3}$$

where α and β are constant, with $0 < \beta < 1$ and $\mu_{i,t}$ is the disturbance term. The condition $\beta > 0$ implies β-*convergence*, because the annual growth rate $logH_{i,t}/H_{i,t-1}$ is inversely related to $logH_{i,t-1}$, which is easily estimable from the available dataset. A higher β coefficient corresponds to a greater tendency of height convergence for those areas characterized by shorter heights that grow faster than areas characterized by taller heights.

Thus, if the coefficient of initial height is negative in a univariate regression, then we can say the data displays *absolute convergence.* Following Barro and Sala-I-Martin (1992a) and Mankiw, Romer, Weil (1992), we can also characterize another measure of convergence, i.e. *conditional convergence*, in which the negative coefficient on initial stature should be found by running a cross-sectional regression of growth on height including macro-regional fixed effects. In this case, the model becomes:

$$\gamma_{i,t} = log\frac{H_{i,t}}{H_{i,t-1}} = a - \beta logH_{i,t-1} + \sum_{k=1}^{K}\bar{z} + u_{i,t} \tag{4}$$

where $\bar{z}$ is the vector of macro-regional fixed effects. Thus, β indicates how quickly the stature H of a population tends to its steady-state.

4.3. Econometric issues. The reverse causation discussed above remains a fundamental concern as the estimated coefficient of β could be biased and cannot be interpreted as reflecting a causal effect of regional (initial) well-being on growth rate. The problem is that the (initial) level of height and the unobserved error term in equation (3) or (4) may be correlated. To cope with this problem, we need some theoretical insights in order to focus on instruments able to make estimation consistent. We rely on the findings of Tabellini's (2010) paper to state that historical features shape the culture of the inhabitants of a region or country and, in turn, their economic development. In the same vein, historical economic and social issues of earlier generations in Italy may partly explain recent well-being. For example, Italy experienced a North-South divide in height in the first decade of the 20th century and the literature generally explains this result by way of deficit efficiency on government expenditure addressed to public and sanitary infrastructures in the South during the period 1890-1930. The inefficiency of public expenditure increased the regional economic gap and, in turn, the biological welfare. In this setting, we rely on instrumental variable approach, which uses the historical regional heights as instruments for the level of the regional mean height of conscripts after World War II. Past height instruments are measured by the regional mean height of conscripts at the turn of the 19th century and contain the variability between Italian regions in terms of economic development and health circumstances.

These instruments serve to isolate the variation in initial height ($H_{i,t-1}$) that is exogenous (i.e., due to historical variables) from the possibly endogenous variation in initial height ($H_{i,t-1}$) due to the unobserved error term ν. The instrumental variable estimates of the parameter of interest in the height growth regression, β, only exploits this exogenous variation in initial height. Thus, the critical issue shifts away from whether $H_{i,t-1}$ is endogenous to whether our historical variables are valid instruments.

5. Evidence and interpretation of regional convergence in height

The regressions apply to a panel of Italian regions. The dependent variable is the annual growth rates of height over three decades, which cover 1951-1961, 1961-1971, 1971-1980.

Table 3 reports the estimates of absolute and conditional convergence obtained by Three Stage Least Squares (3SLS). In column 1, we list the estimated parameters of absolute convergence. Each regression period contains three members. The first is the estimate of β. Underneath, we report the standard error. Finally, we show the adjusted R^2 of the regression. The point estimates of β have the expected sign and are significant for the first two periods (-0.008, s.e.= 0.003 and -0.021, s.e.= 0.003, respectively), while for the last period the point estimate of β is not significant. As a first conclusion, this implies that the economic growth in the South in the second half of the twentieth century, sustained by massive regional policy, made the lack of economic and well-being in Italy less remarkable between 1961 and 1971 in particular. Although in the post-World War II period Italian regions were reasonably more homogeneous from an economic perspective, with respect to the historical period at the turn of Italian Unification (A'Hearn, Peracchi, Vecchi 2009; Peracchi, Arcaleni 2011), the presence of socio-economic disparities between northern and southern regions of Italy still existed. This evidence may explain the different convergence speeds of height across regions, making the main patterns of absolute convergence questionable.

Tab. 3. *3SLS of regional β-convergence in height (1951-1980 birth cohorts)*

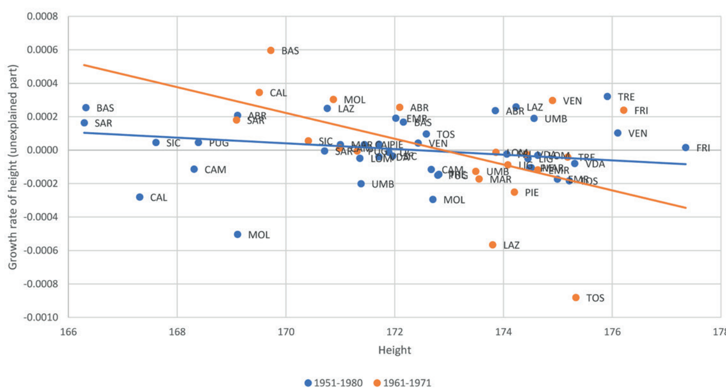
a. Periods		(1) Absolute convergence	(2) Macro-regional F.E.
1951-1961	β	-0.008*	-0.019*
	Std. Error	0.003	0.009
	Adj.R^2	0.232	0.312
1961-1971	β	-0.021**	-0.025**
	Std. Error	0.003	0.008
	Adj.R^2	0.655	0.787
1971-1980	β	-0.005	-0.008
	Std. Error	0.005	0.015
	Adj.R^2	0.016	0.163
b. Interpolated estimates			
	β	-0.011**	-0.014**
	Std. Error	0.001	0.002
	Adj.R^2	0.986	0.983

Notes: *Significant at 5%; **Significant at 1%. Although height in 1971 was missing, we interpolated the conscripts' height between 1969 and 1972 and used it as a proxy for height in that year.

Thus, we include in the estimation differences between government institutions measured as regional fixed effects (the variable *macro-regional fixed effects*), which removes some of these correlations. The results for estimates of β in column 2 of Table 3 are consistent with this perspective. Indeed, the inclusion of the conditional variables in the model specification (3) increases the β-convergence magnitude in the 1961-1971 period, suggesting that although the regional disparities in well-being were, generally, reduced for this period driven by the increasing effects of the economic boom, regional specificities were still important.

As a second conclusion, even if successful regional policy during Italy's «economic miracle» improved sectoral figures of productivity and activity rates, they did not trigger investment and development, such that this success was provisional and bound to revert, as also shown from estimates of height convergence between 1971-1980. Figure 3 plots the partial correlation between the growth rate of height and (initial) level of height for the interpolated full period

Fig. 3. *Conditional convergence in height (birth year) at regional level*



(1951-1980) and the subsample 1961-1971. This representation is consistent with the perspective that the greatest part of well-being growth in the South happened between 1961 and 1971, as the slope of the regression line illustrates it.

Nevertheless, reverse causation remains a concern. We seek to explain whatever is left as the effect of the average historical height on the initial height level of each period investigated and then how it is transmitted on height growth rate, after controlling for common regional effects. Thus, we can rely on the past height measure of conscripts within-regions as instruments, which allows us to investigate the role of height as a mechanism of historical influence among regions. For our analysis, the North-South divide in biological welfare emerged mostly in the pre-World War I period, in the interwar years and not as an immediate consequence of Unification. A motivation largely accepted is that the massive regional intervention from the Italian government at that time enlarged the magnitude of government expenditure for public and sanitary infrastructures, but a deficit of efficiency in the Southern regions increased the economic gap, and in turn, the biological welfare gap (see, for instance, Federico 2003)[4]. To account for historical influence, we should choose a period far enough to justify the inconsistent effects on the growth rate of height of the deputy periods to analyze, but extremely linked with the initial level of height, as a measure of the well-being achieved from a society. We use the regional height of conscripts born in 1871 and 1891 as instruments for height growth regression in the period 1951-1961; height of conscripts born in 1891 and 1910 for the period 1961-1971; and height of conscripts born in 1910 and 1931 for the period 1971-1980. The first stage estimates (not reported) which account for the effect of historical regional height on contemporaneous regional height in the subsamples and the entire 1951-1980 period, show a positive and significant correlation in the first two periods (1951-1961 and 1961-1971) that ranges from 0.45 and 0.62. In the last period, it is not significant. This also implies that the interpolated estimates are significant, even if the magnitude of historical effects is alleviated. Table 4 reports the second stage regression for different sub-periods of height growth regression with robust standard errors. The last two rows report the *F*-statistics for the excluded instruments, and the *p*-value of Sargan test for the over-identification test. Columns (1) and (2) refer to the height growth regression, absolute and conditional convergence (i.e., regional fixed effects), respectively.

Tab. 4. *IV of regional β-convergence in height (1951-1980 birth cohorts)*

a. Periods		(1) Absolute convergence	(2) Macro-regional F.E.
1951-1961	β	-0.007*	-0.010
	Std. Error	0.003	0.004
	Adj.R^2	0.229	0.271
	F-stat	104	61
	Sargan test	0.959	0.081
1961-1971	β	-0.021**	-0.022**
	Std. Error	0.004	0.004
	Adj.R^2	0.654	0.788
	F-stat	91	63
	Sargan test	0.374	0.132
1971-1980	β	-0.003	-0.003
	Std. Error	0.005	0.005
	Adj.R^2	0.000	0.000
	F-stat	53	60
	Sargan test	0.634	0.072
b. Interpolated estimates			
	β	-0.009**	-0.008**
	Std. Error	0.002	0.002
	Adj.R^2	0.986	0.969
	F-stat	104	62
	Sargan test	0.626	0.101

Notes: *Significant at 5%; **Significant at 1%. IV estimation: stature was instrumented using the log of stature at 1871 and 1891 (1951-1961); log of stature at 1891 and 1910 (1961-1971); log of stature at 1910 and 1931 (1971-1980); log of stature at 1871 and 1910 (1951-1980). F-statistics is the F-test of the excluded instruments. Sargan test is the p-value of Sargan statistic testing the over-identifying restrictions.

The effect of initial height on height growth is always large and statistically significant for the period 1961-1971 and with the expected sign for the specification. The *F*-statistics for the excluded instruments are comfortably large, particularly for the specification including regional fixed effects. The over-identification restriction is not rejected in any specification, concluding that initial height does fully capture the channels through which past height variables affect height growth.

In Table 3 and 4 (pattern b), we report on the interpolated parameter estimates over the full period for the different specifications, which allows us *i)* to compare the long-run effect of well-being growth; *ii)* to clarify the magnitude of the endogeneity bias.

Comparing the IV estimates with those of the 3SLS, we see that projecting height on the two historical height variables in IV estimates actually decreases its estimated coefficient on height growth.

For example, for the specification including macro-regional fixed effects, the annual convergence rate in the IV point estimate between 1951 and 1980 reduces the distance in height across Italian regions by 0.9%, while 3SLS estimates suggest an annual decrease of about 1.1%. Thus, the cross regional variation in height that can be explained by historical variables is less strongly correlated with height growth and convergence compared to the overall measures of correlation. However, attenuation bias accounting for reverse causality may not fully explain the differences in estimation. The internal migration from the South to the North of Italy, which was experienced in the 1950s and 1960s, may explain a greater convergence speed in 3SLS estimates. We cannot rule out directly the significant influence of conscripts born in the South and examined in the North of Italy. Lanari and Bussini (2014) used conscript microdata to estimate that during the first two decades of the second half of the twentieth century the intense flows of migration from Southern to Northern Italy artificially increased the speed of height convergence by 24-33%, a dimension that is reasonably in line with the estimates obtained at the regional level.

Since the theoretically predicted length of time required by an economy to fully attain its balanced growth equilibrium is infinity, it is conventional to use the notion of half-life to compare convergence speeds[5]. Note that the half-life is independent of the initial distance from the steady state but depends only on β in percentage. Table 5 summarizes the number of years estimated for half-life height convergence between South and North using the estimates of β parameters. In the conditional convergence specifications, these results indicate that the speed of convergence was slightly overestimated by 3SLS over the period 1951-1980 (49 years instead of 77) and the reduction in regional well-being disparities almost all take places during the economic boom period. Put it another way, if the South had improved its well-being in the full sample as it did during the 1961-1971 period, the disparities would have reduced by 50% in about 30 years, while the slowdown in the successive period (1971-1980), produced an extension of the convergence time.

Tab. 5. *Half-life convergence of height (birth year): number of years*

Specification	3SLS		IV	
	Years		Years	
	1961-1971	1951-1980	1961-1971	1951-1980
Absolute convergence	33	63	27	81
Conditional convergence (Regional F.E.)	33	49	31	77

6. Conclusions

This paper presents a systematic examination of whether height growth is an effective 'outcome' to explain changes in the well-being of Italian society during the economic boom, through military conscript data. We motivate the research questions from the debate over the identification of the determinants of well-being, and in particular, height. A well-accepted phenomenon is that the early-life environment, net of the variability in genetic conditions, is responsible for the mean height growth of a population. Based on this approach, we show that a large variability of the mean height of conscripts at the regional level is explained by per-capita income at birth and exploit this result to evaluate if there was a convergence of well-being between regions of Southern and Northern Italy. The contribution is twofold.

Firstly, we illustrate the two main features of well-being growth: i) the catching up on mean regional height depends on the differences among initial mean height; ii) the convergence of height is derived by realistic assumption supported by the data with an increasing growth rate of height towards the steady state of the Southern regions.

Secondly, the reduction in the disparities in regional height adds evidence for the improvement of well-being in the period 1951-1980. In particular, estimations suggest that a large part of this regional convergence in well-being occurred during Italy's economic boom. We have estimated that the speed of convergence of the Southern regions towards those of the North in the period 1961-1971 was about 2.2%-2.5% per year, therefore predicting that it would take three decades to half Italian regional inequalities in well-being. There is no doubt that the great transformation experienced by Italy during the «economic miracle» thanks to educational achievements, social policies, public financial resources and vast economic improvements may have played a decisive role in determining an increase in the average height and regional convergence. Lastly, also controlling for differences in macro-regional socio-economic circumstances, our findings suggest an overestimation of the well-being convergence during the economic boom. The intense internal migration flows from South to North in the 1950s and, especially, in the first few years of the 1960s may have also affected height increases leading to an artificial greater convergence in height, given the shorter mean height of individuals who migrated from Southern regions.

Summing up, Southern Italy's convergence process only became evident during the years of the 'economic miracle', but this growth subsequently weakened and receded. Indeed, improvements in well-being quickly reversed in 1970s, when massive cuts in regional policy financing were made from the onset of the economic crisis. This meant that the broad economic disparities between Italian regions persisted, with higher levels of income and employment in the North, compared to the South, which lagged behind. As pointed out by Felice and Vecchi (2015), the result is that persisted with different shades 'two Italies', in terms of economic development: on the one hand, the Centre-Northern regions, in which the process of convergence favoured a greater homogeneity among them, and the *Mezzogiorno*, the South, on the other.

[1] It is important to precise that increases in height are not been continuous over time. Some countries in Europe as Great Britain, The Netherlands and Germany among others, experienced a decline in physical stature coinciding with the onset of the Industrial Revolution during the second half of the nineteenth century whereas the downward phase in stature in North America was later from 1830 to 1860 (Floud, Harris, 1997; Komlos 1998). According to Komlos (1998) the so called «early industrial growth puzzle» or «Antebellum Puzzle» – which evidenced a negative correlation between economic growth and stature – was a consequence of the great socio-economic transformations witnessed by the beginning of modern economic growth which enhanced inequalities in the living standard of populations subjected to rapid and important structural changes. Other scholars tend to stress the importance of the disease environment in explaining the height cycles (Riley 1994; Voth, Leunig 1996).

[2] Data for birth cohorts 1854-1920 were published in the Sommario di statistiche storiche (Istat 1958 and following editions 1968, 1976 and 1986), and in the «Annuario statistico italiano» (Istat 1949-2003) for birth cohorts 1927-1980. Although the 1985 birth cohort was the last to experience compulsory recruitment, data for the 1980 birth cohort was the last to be released by the Ministry of Defence. We only lack data for the following birth cohorts: from 1940 to 1944 and 1966-1968-1970 and 1971 (delivery irregularities from the Ministry of Defence to Istat). For an exhaustive investigation into the quality of Italian military conscript data, please see Arcaleni (2006).

[3] Conscripts' height regional data were reported by Istat for the 1927-1940 birth cohorts and continuously from 1945 to 1965 (Istat 1949-2003). Data for conscripts were missing for 1966, 1968, 1970 and 1971 (see Istat 1958; 1968; 1976; 1986). Homogeneous regions involved in the empirical analysis were sixteen: Piedmont, Lombardy, Liguria, Veneto, Emilia-Romagna, Tuscany, Umbria, Marche, Latium, Abruzzo, Campania, Apulia, Basilicata, Calabria, Sicily, Sardinia.

[4] Putnam, Leonardi, Nanetti (2001) argued that the pronounced differences in civic, social, and economic behaviour between Northern and Southern Italy can be traced back to their distant histories and traditions, and that these different endowments of 'social capital' help to explain the lack of economic development in Southern Italy.

[5] The log version of half-life corresponds to the time at which height equals its geometric mean and the regional steady state of height. Formally:

$$\tilde{T} = \frac{1}{\beta} log2.$$

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Riassunto

Miracolo economico e benessere in Italia. Un'analisi della convergenza regionale della statura dei coscritti militari a metà del XX secolo.

Questo lavoro presenta nuove stime a livello regionale dell'impatto sulla statura, utilizzata come *proxy* del benessere, del processo di crescita economica in Italia, meglio definito come il 'miracolo economico', nella seconda metà del Novecento. I risultati evidenziano come gran parte della convergenza regionale nella statura si sia verificata durante il 'boom economico', quando si registrò una velocità di convergenza delle regioni del Sud rispetto a quelle del Nord tra il 1960 e il 1970 pari a circa il 2,2-2,5% annuo, con un rilevante rallentamento a partire dagli anni Settanta del Novecento. Discutiamo questi risultati alla luce della grande trasformazione vissuta dall'Italia, affrontando anche la questione se le migrazioni interne da Sud a Nord abbiano contribuito a sovrastimare la velocità di convergenza della statura. La risposta è affermativa.

Summary

The economic miracle and well-being in Italy. An analysis on regional convergence in military conscripts' height during the mid-twentieth century

The paper presents new estimates at regional level of the impact on height, as a proxy of well-being, of the process of economic growth known as the "economic miracle" which occurred in Italy during the mid-twentieth century. Our findings suggest the large part of the regional convergence in height occurred during Italy's economic boom in which the speed of convergence of the Southern regions towards those of the North in the period 1960-1970 was about 2.2-2.5% per year, slackening since the 1970s. We discuss the results in the light of the great transformation experienced by Italy, also dealing with the question of whether internal migration from South to North contributed to the convergence over-estimation in height. The response is an affirmative one.

Parole chiave

Statura; Benessere; sviluppo economico; convergenza regionale; Italia.

Keywords

Height; Well-being; economic development; regional convergence; Italy.